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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 156

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HH-1N IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB. H K HILLE

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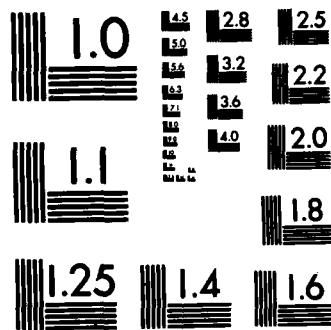
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Volume 156



USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 156

HH-1N IN-FLIGHT CREW NOISE

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



HENNING E. VON GIERKE, Dr Ing
Director
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The HH-1N is a USAF multi-purpose utility helicopter providing support for various USAF missions. This report provides measured data defining the bioacoustic environments at flight crew locations inside this helicopter during normal flight operations. Data are reported for two locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1.		

of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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INTRODUCTION

The HH-1N is a multi-purpose helicopter providing support for various Air Force missions. This helicopter, which is manufactured by the Bell Helicopter Textron Company, is powered by the T400-CP-400 Turbo "Twin Pack", consisting of two PT6 turboshaft engines coupled to a combining gearbox with a single turboshaft flat-rated to 1250 shp max power. The engines drive a two-blade rotor with a diameter of 12m and a conventional two-blade tail rotor. The engines are manufactured by the Pratt and Whitney Aircraft Company of Canada.

This volume provides measured data defining the bioacoustic environments produced inside the helicopter. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the HH-1 helicopter.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AFAMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AFAMRL/BBE, Wright Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50(1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured HH-1N helicopter during typical speed, altitude, and flight maneuver conditions. These levels describe the standard HH-1N environments, but may not be representative of those levels encountered if the helicopter has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at two flight crew/passenger locations with the doors and front windows closed and open as indicated in Table 1. This open condition creates airflow of up to 10 knots in velocity inside the helicopter. The wind direction is random and is affected partially by the attitude of the helicopter. A windscreens was used for all data runs to significantly eliminate the turbulence that normally would be generated around the microphone and would otherwise appear in the data as relatively low frequency noise. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone was randomly moved external to the headgear in a region 0.2-0.3 meter from the head and the resultant samples analyzed using a 4- or 8-second integration time to obtain a power-averaged level, which effectively smooths out short duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the HH-1N helicopter at the specified location. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1
MEASUREMENT LOCATIONS AND TEST CONDITIONS
HH-1N, Kirtland AFB NM
Serial No. 233, 25 May 1981

Location	Position	Height Above Deck
1	Between Pilot and Copilot	Seated Head Level
2	Seat, Back Row	Seated Head Level
Condition	Description	
A	APU Running - Doors Open	
B	Engine Start, APU Running - Doors Open	
C	Engine Start, APU Running - Doors Closed	
D	Ground Runup - Doors Open	
E	Liftoff and Hover 5' Above Ground - Doors Closed	
F	Liftoff and Hover 5' Above Ground - Doors Closed	
G	Cruise - 500' - 80 KIAS, Front Windows and Doors Open	
H	Cruise - 500' - 80 KIAS, Front Windows Open - Doors Closed	
I	Cruise - 500' - 60 KIAS, Front Windows Open - Doors Open	
J	Descent - Left Door Open	
K	Descent - Doors Closed	
L	Landing - Left Door Open	
M	Liftoff - Left Door Open	
N	Hover - 10' Above Ground - Left Door Open	
O	Cruise - 500' - 80 KIAS, Doors Open	
P	Approach and Descent from 500' - 80 KIAS, Front Windows Open - Doors Closed	
Q	Hover 50' - High Torque - Doors Open	
R	Hover 50' - High Torque - Doors Closed	
S	Hover Above Ground - Rotate 180°	
T	Taxi	
U	Touch Down - Landing	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)
1/3 OCTAVE BAND

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)
2
 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT:	OPERATION:	LOCATION/CONDITION						IDENTIFICATION:			
		1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S	1/T	1/U
FREQ (HZ)											
25	HH-1N IN-FLIGHT	92	91	89	96	102	87	87	85	82	87
31.5	CREW NOISE	94	95	92	98	100	97	93	93	93	83
40		89	90	89	95	96	85	84	84	87	82
50		87	90	88	93	95	90	88	90	90	83
63		84	89	84	89	92	88	87	86	88	84
80		81	85	83	88	91	83	83	85	86	78
100		85	95	92	91	88	87	86	88	88	79
125		82	90	80	88	85	85	82	84	86	72
160		85	89	87	86	86	86	79	84	84	76
200		84	90	86	85	88	85	80	82	84	77
250		85	89	87	88	87	86	80	82	82	79
315		83	89	87	91	90	88	84	83	85	80
400		82	89	88	89	89	87	81	84	84	79
500		84	89	85	84	85	85	82	83	81	81
630		84	90	84	86	87	86	83	84	83	78
800		81	85	82	85	86	84	78	77	74	
1000		79	85	81	80	80	82	77	76	76	74
1250		77	83	79	79	80	80	77	75	75	70
1600		75	80	76	76	78	79	77	80	79	73
2000		74	79	75	76	76	78	77	76	75	68
2500		71	75	72	73	76	74	72	72	68	66
3150		71	75	77	73	77	74	73	75	72	68
4000		73	78	72	74	76	73	70	75	69	66
5000		71	75	71	72	74	73	68	71	68	64
6300		71	75	73	72	74	75	69	70	68	64
8000		73	77	74	71	74	76	69	70	69	68
10000		81	84	77	73	74	79	73	73	72	70
OVERALL		99	103	100	103	106	101	98	98	99	93

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		LOCATION/CONDITION											
2 OCTAVE BAND		1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	2/I	1/J	1/K
NOISE SOURCE/SUBJECT:	OPERATION:												
HH-1N IN-FLIGHT													
CREW NOISE													
FREQ (HZ)													
31.5	80	92	90	93	98	93	104	96	108	107	100	94	
63	86	89	87	91	95	91	96	91	102	98	91	89	
125	88	92	90	94	96	92	95	89	103	94	89	89	
250	84	92	90	94	94	89	94	89	102	91	86	86	
500	81	91	91	95	93	89	92	89	97	92	86	86	
1000	81	88	88	92	91	82	86	82	93	89	80	80	
2000	75	80	81	84	85	77	80	77	86	81	75	77	
4000	68	76	76	79	82	75	76	75	83	80	77	75	
8000	71	80	79	83	85	79	75	71	84	79	75	74	
OVERALL	92	99	97	101	103	98	105	99	111	108	101	97	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)

2

OCTAVE BAND

) IDENTIFICATION:

) OMEGA 3.2

) TEST BG-082-001

) RUN 02

) 03 SEP 82

) PAGE J2

NOISE SOURCE/SUBJECT: OPERATION:

MH-1N IN-FLIGHT

CREW NOISE

FREQ (HZ)	LOCATION/CONDITION					
	1/L	1/M	1/N	1/O	1/P	1/Q
	1/R	1/S	1/T	1/U		
31.5	97	97	95	101	105	97
63	69	93	90	95	98	92
125	89	97	95	93	91	91
250	89	94	91	93	91	86
500	88	94	91	91	92	87
1000	84	89	85	87	87	89
2000	78	83	79	80	81	82
4000	76	81	79	78	78	79
8000	82	85	80	77	79	82
OVERALL	99	103	100	103	106	101
					98	98
					99	99
					93	93

TABLE: MEASURES OF HUMAN NOISE EXPOSURE

3

TABLE: MEASURES OF HUMAN NOISE EXPOSURE									
3									
NOISE SOURCE/SUBJECT:		OPERATION:		LOCATION/CONDITION					
HH-1N IN-FLIGHT				1/A 1/B 1/C 1/D 1/E 1/F 1/G 1/H 1/I 2/I 1/J 1/K					
CREW NOISE									

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE

3

NOISE SOURCE/SUBJECT:		OPERATION:		LOCATION/CONDITION				IDENTIFICATION:									
MH-1N IN-FLIGHT						OMEGA 3.2											
CREW NOISE						TEST BG-082-001											
						RUN 02											
						03 SEP 82											
						PAGE H2											
1/L		1/M		1/N		1/P		1/Q									
1/R		1/S		1/T		1/U											
HAZARD/PROTECTION																	
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR																	
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR																	
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)																	
NO PROTECTION																	
OASLC	98	102	99	102	104	99	96	97	98								
OASLA	90	95	91	92	93	92	89	90	89								
T	170	71	143	120	101	120	202	170	202								
HGU-2A/P HELMET WITH CUSTOM LINER																	
OASLC*	86	92	88	89	90	89	84	85	85								
T	339	120	240	202	170	202	480	404	404								
U-51R EAR PLUGS																	
OASLC*	67	72	69	70	71	69	65	66	66								
T	960	960	960	960	960	960	960	960	960								
H-157 IN-FLIGHT COMMUNICATION UNIT																	
OASLC*	73	79	77	78	78	76	72	73	74								
T	960	960	960	960	960	960	960	960	960								
COMMUNICATION PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)																	
PSIL	83	89	85	86	87	87	83	84	83								
ANNOYANCE																	
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)																	
TONE CORRECTION (C IN DB)																	
PNLT	104	109	107	106	107	106	103	105	104								
C	1	1	2	1	0	1	1	2	1								
BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.																	